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ABSTRACT

Presented is a bibliography that cites research studies and articles related to Science Curriculum Improvement Study (SCIS), and provides a brief summary of these research studies and articles and some commentary within 5 categories. These 5 categories are: (1) SCIS and teachers, 8 studies or articles are reported within this category which are concerned with implementation, attitudes and personality traits, cognitive and teaching styles; (2) SCIS and learners, 12 articles are reported within this category which deal with cognitive aspects of learners, processes of science, self concept and learners with certain physical handicaps; (3) SCIS and language development-reading, 5 studies are reported within this category; (4) SCIS development, content and evaluation, 10 studies and articles are reported within this category; and (5) Science and reading, 22 studies and articles are reported within this category which are concerned with the relationship between science and reading-language development. (HM)

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A Bibliography of Research and Articles Related to Science Curriculum Improvement Study (SCIS)

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CENTER FOR IMPROVING
ELEMENTARY SCHOOL SCIENCE
AND MATHEMATICS

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INTRODUCTION

In the early 1970's Rand McNally and Company printed a pamphlet titled "Research Studies of SCIS Success in The Classroom." This pamphlet cites seven (7) studies which are divided into three categories:

1. Pupil achievement of SCIS goals
2. SCIS influence on other academic areas
3. Changes in the classroom behavior of SCIS teacher

The intent of this bibliography is to update the previous citations providing a summary of studies and some commentary within four major categories. Although much effort was expended to execute a complete review of the literature pertaining to SCIS through June 1978, it is quite likely some studies and reports were overlooked. Special thanks are due DeAnna Lockhart and Frances Karanovich, Graduate Research Assistants and Center staff members, for their work on this project.

I. SCIS AND TEACHERS:

Eight studies or articles are reported in this section. These studies are concerned with implementation, attitudes and personality traits, cognitive and teaching styles.

T.C. Moon (1977) stated that his study reinforces the fact that individual teacher attitude affects the success of curricular

innovations. He also noted that adequate inservice instruction should focus upon the philosophy, rationale and objectives of the program and also preparation time, use of guides and other materials.

As reported by L. R. Bruce (1969), the SCIS teacher asks more higher level (analysis) questions of students and fewer recall questions, there exists a positive relationship with changes in scores on the Science Process Test and proportion of high level questions, and a significant relationship between the Science Process Test and the Minnesota Teacher Attitude Inventory. Bruce (1971) stated that SCIS involvement did not change teachers' attitudes toward teacher-pupil relationships nor was there a significant correlation in questioning behavior and MTAI score.

In a study of SCIS implementation and teaching style, T. T. Southerland (1972) concluded that teachers became less direct in classroom tactics, developed a better understanding of science and improved their attitude toward science. Pringle and Morgan (1978) found that SCIS type laboratory experiences contributed to a more field-independent cognitive style in graduate students enrolled in a science education course. Teachers using SCIS also provided more essential science experience, used more exercises in demonstrating skills, and asked fewer recognition and recall questions than teachers of traditional programs (Renner and Stafford 1970).

Johns (1970) suggested that the SCIS learning cycle - explore, invent, discover - may be used with teachers to promote "some basic thinking on a real problem," and Za'rour and Jirmanus (1977) discuss implementation of SCIS in a Lebanese School.

In summary, these implications may be drawn from the above research.

1. Teachers' attitudes toward the program and science are more positive.
2. Teachers use higher level (more analytical) questions and questioning skills.
3. Teachers have greater skill in processes of science and understanding science.
4. Teachers provide more experiences for students.
5. Teachers develop a more analytic cognitive style.

It follows, of course, that SCIS should not be used if these qualities are undesirable.

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Za'rour, G.I. and R. Jirmanus, "SCIS in a Lebanese school," School Science and Mathematics, 77, pp. 407-17, 1977.

II. SCIS AND LEARNERS:

The articles reviewed within this category are more numerous than other categories. These 12 articles treated certain cognitive aspects of learners, processes of science, self concept and learners with certain physical handicaps.

In an attempt to ascertain what a SCIS child would say or do at the end of Grade 1 versus the non-SCIS child, Allen (1970) stated that a SCIS child exhibited significantly more exploratory behavior but was superior only in the ability to serially order. Work with second grade children revealed to Allen (1972) that SCIS objectives seem to be met and that SCIS children were superior in cognitive behavior but were no better than the control group in affective motivational behavior. SCIS children at the third level were superior in cognitive and explanatory behavior according to Allen (1973).

Garigliano (1975) reported that only about half of a group of third graders could conserve and handle an activity related to the systems concept. Only 26 of 125 achieved a perfect score on a paper-pencil test he administered.

Fifth graders who took the SCIS Energy Sources unit appeared to be better logical thinkers than fifth graders who had not taken the unit. Furthermore, students of energy sources were close in scores to eighth graders in comparable areas (Linn and Thier, 1975).

Using second, third and fourth grade children, Allen (1968) compared SCIS and non-SCIS groups on classificatory ability. No significant difference in mean performance, either overall or on individual task, was found. Allen suggests that these upper middle

socio-economic groups normally acquire the skills tested prior to school and this aspect of the SCIS program is not powerful enough to exceed the effect of the normal environment. Weber (1972) stated, "Data clearly indicated the superiority of the SCIS curriculum over the textbook curriculum for developing the students ability to utilize science processes."

In a study concerning self concept, Krockover and Malcolm (1977) suggested that programs such as SCIS elevate the way a child feels about himself by encouraging creative, innovative, independent thinking. Self concept development may be enhanced by the classroom environment SCIS helps to create.

With culturally diverse, visually impaired first graders, Linn and Patterson (1973) found that SCIS increased classificatory ability, permanance of property was learned and logical thinking was fostered. Struve and others (1975) reported that an adapted SCIS program resulted in significant gains on content and process objectives for visually impaired elementary students. Two articles (Linn and Thier 1975; Schatz et.al., 1976) discuss various aspects of the SCIS adaptations for the blind.

Some articles reported below also contain data and implications concerning learners although it was deemed more approrpiate to place these articles in the categories as indicated.

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Struve, N.J. et.al., "The effect of an experiential science curriculum for the visually impaired on course objectives and manipulative skills," Education of the Visually Handicapped, pp. 9-14, March 1974.

Weber, M.C., "The influence of Science Curriculum Improvement Study on the learner's operational utilization of science processes," Southwestern State College, Weatherford, Oklahoma, EDRS Microfilm, 16 p., March 1972.

III. SCIS AND LANGUAGE DEVELOPMENT-READING:

Does a day go by in which the topic of reading and schools is not contained in someone's conversation somewhere? Who questions the idea

of reading being a basic school subject? Of all monies expended in the name of instruction, producing and procuring instructional material for the elementary school learner and preparing our youth for tomorrow - what subject area of the curriculum receives the most? Of the in-school hours, what subject area consumes the bulk of this time? To question such ideas, or such expenditures of money and time would likely be labeled revolutionary, heretical.

Five studies are reported in this section. Some of the content of the articles reviewed in the next section of this bibliography are related to this category and more with regard to science and reading is found in the latter part of this document.

Children learning to read should experience science because "participation in science activities is an excellent vehicle to enhance many of the 'readiness' and communication skills so vitally important in today's world" (Barufaldi and Swift, p. 392, 1977). These authors illustrate many similarities in sciencing and reading/languaging skills.

Using beginning fifth graders, Cahn and Moak (1973) found significant differences in favor of SCIS students in reading paragraph meaning, also in mathematical applications and social studies skills as measured by the Stanford Achievement Test. They report no differences in mathematics skills and concepts, social studies content and reading word meaning. Maxwell (1974) also found the SCIS activities produce positive and significant effects on kindergarten children's reading readiness scores. Morgan, Rachelson and Lloyd (1977) found a significant difference in the development of certain reading skills with first graders using SCIS materials.

Using both SCIS and ESS materials, Bybee and Hendricks (1972) found that deaf children learned science concepts, increased vocabulary approximately 25 percent, improved reading skills and developed positive attitudes toward themselves.

Which is more basic - reading or sciencing?

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IV. SCIS DEVELOPMENT, CONTENT AND EVALUATION:

SCIS had its beginnings about 1962 when the National Science Foundation was funding massive curriculum development projects. SCIS became commercially available around 1968 and in 1978 was available in revised editions. Kratochvil and Crawford (1971) described and discussed SCIS origins and a summative evaluation is provided.

The environmental aspects of SCIS were discussed in an article by Lawson (1971). Further, Lawson (1975) provided a detailed description of the SCIS life science units as a model of curriculum development. Simpson (1975) contrasted the biologic content of three

elementary school science curriculum projects. He reported the approximate amounts in the projects as SCIS-50%, ESS-33% and SAPA-25%.

One study of SCIS' effectiveness was done by Weber and Renner (1972) who reported that SCIS was an effective program for developing students' ability to use science processes. Another study (Renner et.al., 1973) provided data with regard to the effectiveness of SCIS in increasing intellectual development and influencing achievement in mathematics, reading and social studies. Similar data and findings were reported in 1976 by Renner and Coulter. A major goal of SCIS is scientific literacy and Brown, Weber and Renner (1975) have reported an investigation of its attainment. Appel and Stolte (1970) ranked SCIS highest of seven elementary school science programs in terms of curriculum and instruction characteristics and practicability. The validity and reliability of concept/process assessment instrument for the SCIS organisms unit have been investigated by Perry and Merkle (1976).

Many of the studies and articles in this section are pertinent to theother categories of this bibliography.

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V. SCIENCE AND READING - IS THERE A RELATIONSHIP?

A great deal of the research in science education within the past 10 years has been concerned, in whole or in part, with the relationship between science (especially that labeled inquiry-oriented science) and reading-language development. It is probable that some of the motivation behind this research activity derives from the desire of science educators to secure a respectable place for science in the school curriculum - especially elementary school. That science does not hold such a position is evidenced by data collected in numerous surveys, direct observation, and the general reference to reading and mathematics (and writing) as being the basic school subjects. For example, the principal of an elementary school in one of Georgia's largest school systems told a first grade teacher not to include

science in her lesson plans which must be submitted to the administration because instructional time should be devoted to reading and math. This system did initiate an activity oriented science program a few years ago for grades 4, 5 and 6, but the primary or 1, 2, and 3 grades were excluded. Interestingly, the system's kindergartens Science Curriculum Improvement Study (SCIS) materials is on the approved list of supplies and these materials are found in some of the kindergarten classrooms.

Some impetus was probably provided for science-reading research when Almy (1966) reported

> ....the findings in our studies of a rather substantial correlation between performance in conservations tasks and progress in beginning reading suggests that, to some extent, similar abilities are involved. A program designed to nurture logical thinking should contribute positively to reading readiness....

It has long been the contention of the practitioners that science methodologies foster logical thinking (also called rational thinking, among other labels). In practice, however, much of the "teaching" of methodology has to do with the memorization of steps in the scientific method rather than actually experiencing the methods. To wit: A January issue of the Atlanta Journal - Constitution printed a list of questions used as a type of exit examination for high school students. One of the two "science" questions in the list asked for the sequencing of the steps in "the" scientific method. Other categories in the list did include environment and technology. In any event, research to date indicates a relationship between reading and logical thinking and science and logical thinking.

Researchers of recent date do lend support to the following statements.

1. Activities in science expand one's vocabulary.
2. Vocabulary is prerequisite to reading.
3. Reading skills stem from language and logic development which come after concepts are formed from repeated encounters with objects and events.
4. Such encounters are provided by science experiences.
5. Science experiences appear to be especially helpful for those who are considered culturally different.
6. Science activities provide a strong stimulus and a shared framework for converting experiences into language.
7. Selected science experiences accelerate reading and appear to contribute positively to many reading skills.

Inasmuch as few, if any, questions are really settled, additional research is always to be desired. Considering what is revealed in the research cited below, it seems appropriate to ask these questions:

1. Should science be considered a basic school subject?
2. Which is more fundamental, science or reading?

As previously cited, Renner (1973) concluded that first level SCIS greatly enhances a child's ability to conserve (a logical operation involving keeping track of quantities of a substance despite changes in shape) and the ability to conserve contributes to reading readiness. Ayers and Mason (1969) explored the effects of SAPA on reading readiness scores. Also, Ayers and Ayers (1973) considered the use of logic in kindergarten children.

Huff and Languis (1973) examined the effect of science activities on oral communication and Hibbard (1973) looked at verbal predictive ability and concept attainment. Accelerating the attainment of the concept "tree" is discussed by Klausmeier (1976). In 1966, Horn presented three methods of developing reading readiness in Spanish speaking first graders and science methods and reading was a concern of Lucas and Burlando (1975).

Others who have explored reading readiness and science relatedness include Neuman (1970), Newport (1969), Ritz (1969), and Wellman

(1971). Campbell (1972) and Olson (1971) have investigated science and reading with upper grade elementary school students.

Some broader aspects of interrelatedness of science with language development, logic, intelligence, and television teaching have been examined by Kraft (1961), Kolebas (1971), Laffey (1972), Quinn and Kessler (1976), Rowe (1974), Lawson and Renner (1975). Stemmler (1966) reported on an experimental approach in oral language and reading.

In summary, research has provided a substantial basis for considering science, especially inquiry oriented science, a fundamental area of study. Reading can be effectively taught through the learner's active involvement with science content rather than using readin to teach science content. Such activity also increases the learner's accomplishments in mathematics, social studies, other communication skills, logic and self-concept. Science IS a basic school subject.

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